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INSTRUCTIONS

FOR

MAKING

HIGH-ETHER RUM.

BY

H. H. COUSINS,

Island Chemist.

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GENERAL PRINCIPLES.

The Flaveur and Smell of Jamaica Rums are principally dependent on the presence of certain characteristic.

Ethers.

Our rums are superior to most other rums produced in the world and are characterised generally by a higher content of Ethers. This is especially marked in comparison with rums produced by quick fermentation without dunder and distilled in patent continuous stills, such as Demerara rum.

We produce in Jamaica the following classes of rums each specially adapted for a special trade.

CLASS I.

Drinking Rums for local consumption. These are light rums that age quickly and are, as a rule, too light in body for the English market where they bring 2d. to 4d. per gallon less than rums of *Class II*.

I would take as a very fine illustration of this class of rum, Appleton rum famous in Jamaica as a fine drinking rum. This rum has a content of a little over 200 parts of Ethers and has a pleasant, mellow flavour.

The Vere rums are also many of them of this class and command a ready sale in the island. These rums result from low settings and age quickly. They contain from 180 to 250 parts of Ethers.

There are also some good drinking rums produced on the North Side, some as low as 100 parts of Ethers but of very pleasant taste and quality.

As quick ageing is the chief factor for the local trade, it does not appear desirable to increase the body of these rums. Good stillhouse management and the production of a high yield of a light, pleasant-flavoured spirit free from dry and harsh taste is the chief requirement. I do not advocate any attempt to increase the Ethers in this class of rum for local consumption.

When, however, these rums are exported a difficulty arises. A Jamaica rum with only 100 Ethers could not be distinguished from a good Demerara or a blend of high grade Jamaica and Demerara, except perhaps by an expert in tasting rums and even then the human estimate could easily be at fault.

It is desirable that these rums should not be exported as Jamaica rums at this low standard of Ethers because they lower the standard of trade and reduce the blender's standard to that of a low minimum. This has two effects, one a depreciation in the value of genuine high grade Jamaica rums and secondly a reduction in the proportion of Jamaica blending rums used by the merchants to grade-up the patent still rums low in Ethers.

Jamaica has at present a monopoly of Ethers in rum and any means of raising the ether standard in commercial rum for general consumption will react to our advantage in the competition for the world's supply of rum.

A *standard of* 200 *parts of Ethers* has been proposed by Dr. Wiley, the United States Government Chemist and by chemists in England. This is a standard *readily attainable* in Jamaica if there be reasonable fermenting space, without adopting special methods, while the grading-up of any portion of the crop below this standard can be readily accomplished by making a few puncheons of High-Ether rum. Say that the rum for the crop only averages 150 parts of Ethers, a low standard, one puncheon of a 3,000 Ether rum would serve to grade up 60 puncheons to the standard and the extra cost of manufacture to the estate would not exceed 20s.

CLASS II. *Good drinking Rums for the English Market.*

These rums are marked by a characteristic fruitiness or mellow body. Trade experts rightly say that Ethers do not constitute the commercial value of rum. Cases can be quoted where a rum of 110 Ethers from West moreland will bring 3d. or 4d. per gallon more than a rum of Class I. at 350 parts of Ethers. *It is entirely irrational to maintain the position that the actual content of the total Ethers in a rum measures its commercial value.*

To explain this point it is necessary to say something of the chemistry of the Ethers in rum.

(a) What is an Ether?

When Lime or Soda are added to an acid, they combine with the acid *neutralising* its acidity and producing a *salt.*

Alcohol (the chief component of rum) reacts towards acids in somewhat the same way. If an acid, fermented liquor be distilled, an appreciable combination of the alcohol and acid results. The product of this combination, if volatile, comes over in the distillate and imparts to it a fragrant smell. The alcoholic salts of organic acids found in rum are called 'Compound Ethers' or shortly 'Ethers.' To distinguish them from anhydrous alcohols or Ethers proper, such as ordinary Sulphuric Ether of Surgery, Chemists call the compound Ethers, *Esters.*

It should be understood that the terms 'Ethers,' 'Compound Ethers,'

and 'Esters' as applied to rum all mean the same, viz., volatile alcoholic salts of organic acids.

(b.) *What conditions favour the production of Ethers from alcohol and acids?*

The chemistry of Ether production is very simple:

Alcohol + Acid = Ether + Water.

The action, however, is incomplete because it is readily reversed: e.g. Ether + Water = Alcohol + Acid.

Given a certain amount of alcohol and acids in a watery liquid, as in the manufacture of rum, there will always be a certain maximum amount of Ethers that can exist at any time dependent upon:

(1) the relative proportion of alcohol and acid.
(2) the time in which they have been able to react.
(3) the relative proportion of water in the liquid to the Ether produced.
(4) the temperature.

General Laws of Ether Production.

(1) The higher the acidity of an alcoholic liquid the greater the amount of Ethers produced: e.g. A common clean wash at 1% acidity will yield a 200 ether rum, whereas a Trelawny liquor at 3% acidity will give a 1000 Ether rum.

(2) The less water in proportion to spirit present the more Ethers produced: e.g. a certain amount of acidity will give ten times more Ethers in the high wines with 60 per cent. alcohol as compared with liquor containing, say 6 per cent. of alcohol.

(3) The production of Ethers is slow and takes time. Five days are required at the ordinary temperature for a full production of Ethers in a liquid.

If heat be applied, however, the action is greatly expedited.

Where German rums are made containing 1,000 Ethers and more, it has been found an advantage to add acid material to the dead wash and to leave it for some days to react. In the case of High Wines I have found 24 hours to be the minimum time necessary to secure a good yield of Ethers from acids and 48 hours will result in a yield of perhaps 25 per cent. more Ethers in the rum produced by distillation.

(4) The presence of a little Sulphuric Acid encourages Ether production.

About 2 lbs. in 100 gallons of High Wines to which acids have been added is a desirable excess of Sulphuric Acid to maintain where a high yield of Ethers is desired.

(c) *What are the Ethers in Rum?*

Jamaica rums as analysed at the Government Laboratory appear to contain:

Acetic Ether	.. ..	97%
Butyric Ether	.. ..	1 to 1½%
Higher Ethers	.. ..	½ to 1%
Formic Ether	.. ..	traces.

Expressed as percentages of the total Ethers.

Let us consider these in detail:

Acetic Ether.

This forms the chief ingredient of the Ethers of rum. It is with the exception of Formic Ether which is only present in traces, the most volatile of the Ethers of rum and boils at a slightly lower temperature than alcohol. It is on this account that planters say that poor cooling arrangements result in great loss of Ethers. The first runnings are often very rich in Acetic Ether and undoubtedly a great loss of Acetic Ether takes place if rum is distilled hot or exposed freely to the air.

Acetic Ether has a pleasant fragrant smell and gives a pleasant taste to rum. When present in excess it stings the nose when smelling rum in a glass and is called by the trade " pepper."

By itself, Acetic Ether is of very small value as a rum flavour. It is so volatile that when exposed to the air for a few hours a glass of rum will lose the greater portion of its Acetic Ether. Again, when the rum is broken down with water the smell is almost entirely covered and the fragrance is lost.

An increase in the Acetic Ether content of a common, clean or even a high-class rum, if not supported by an increase in the other Ethers in suitable proportion will not add to its intrinsic commercial value.

That is the meaning of the trade dictum 'rums are not sold on Ethers.'

On the other hand, it has been shown that nearly the whole of the Ethers of rum consist of Acetic Ether and therefore the economical and regulated control of the production of this Ether is of importance to all producers of Jamaica Rum.

How is Acetic Ether produced?

Acetic Acid results from the oxidation of alcohol by the vinegar ferment.

In the common, clean process an abundant supply is produced by the spontaneous acidification of the wash which occurs during the alcoholic fermentation.

In the preparation of Westmoreland rums, the skimmings are allowed to sour before being used, while in the manufacture of flavoured rums a special acid cistern is kept going for a supply of this material.

For economy, it is desirable when making flavoured rums to operate a special series of fermenting vessels for the efficient production of Acetic Acid.

If cane juice or skimmings be soured direct, only about ¼ of the acid produced is acetic, the greater proportion, about ¾, being lactic and other non-volatile acids that can not enter into the composition of rum. It would save material, therefore, to run a special " quick vinegar" process. Set up some weak liquor without dunder at say 14 or 15 Arnaboldi or 10° Brix and let it attenuate to ' water.' Then allow this to flow through wooden vessels 4 feet square and 4 feet in depth packed with wooden shavings resting on a perforated false bottom. A series of holes round the lower edge of these chambers admit air. A false lid some six inches below the top of the vessels is filled with say 12 1-inch holes armed with short bamboo tubes for ventilation, while every square inch a small hole is bored through which cotton waste is drawn so that the liquor will drip slowly all over the upper surface of the shavings.

By this means a quick and economical production of vinegar is assured.

Butyric Ether.

This Ether, when prepared from sugar cane materials is of a pleasant fruity odour and a very desirable constituent of all rums of good body and bouquet. A broker in London would call a rum that was rich in Acetic Ether and well supplied with the heavy body and fruit Ethers "stalky" if no Butyric Ether be present.

The artificial and chemical Ethers of commerce always contain some unpleasant product and therefore artificial Butyric Ether can not be used successfully in rum. The impurities from the Butyric fermentation of cane products have both a pleasant odour and taste and are all desirable constituents of rum.

Production of Butyric Ether.

Mr. Allan, the Fermentation Chemist, has been studying the butyric fermentation of Jamaica rum and gives his opinion that this presents one of the greatest difficulties that distillers have found in Jamaica in making flavoured rums.

Butyric Acid cannot be made from Acetic Acid but *is mainly produced from Sugars and Lactic Acid by fermentation in the absence of air.* The dunder produced in Jamaica is always rich in Lactic Acid and rotten dunder will often yield Butyric Acid freely. The thick head forming on such material serves to keep out air and then the butyric ferment can operate. I have been expermenting on this matter and am inclined to the opinion that Butyric Acid should be prepared in a separate process.

Unfermented sugary material, dunder deposit (dead yeasts) and a little marl to neutralise the acid produced together with some surface soil which is rich in butyric ferments should be left to ferment. Also cane trash should be added. A thick heavy scum should soon rise and the conditions for butyric fermentation be favourable. After the liquid is matured, a little Sulphuric Acid, about ¼ the weight of the marl added, say 20 lbs. per 100 gallons, should be added. A little of the clear liquid should be tested with Calcium Chloride Solution. If no precipitate, there is no excess of Sulphuric Acid, if a white precipitate forms add temper lime carefully with stirring until no free Sulphuric Acid can be detected.

If distilled with dunder this liquid should yield an acid distillate that is rich in Butyric Acid and of great value for introducing into the High-Ether process.

Butyric Ether boils at a much higher temperature than Alcohol but is volatile and readily comes over with the rum in quantity required to flavour the spirit. It has a pleasant fruity smell, bland and soft, rather suggestive of pineapples. When present in a rum it meets the nose immediately with the Acetic Ether to which it gives substance and soft delicacy of aroma. It mellows the rum flavour and is desirable to a certain extent in all Jamaica rums.

Only 1 to 2 per cent. of the total Ethers should consist of this Ether. In ordinary rums this proportion is controlled by the normal bacterial changes that occur in the distillery.

Higher Ethers.

Smell Hampden rum 'pineapple flavour,' Ettingdon rum 'fruity flavour' and Cave Valley rum 'buttery flavour' and an idea will be obtained as to the varying quality and aroma of the 'Higher Ethers.' The Westmoreland rums as a class appear to me to be marked by the presence of an unusual proportion of 'Higher Ethers' in proportion to Acetic Ether. Each mark seems to have some peculiarity of character in this respect.

From a careful study of the matter and such limited information as is obtainable in the first chemical studies of such a vast and unexplored field of knowledge, I am inclided to the opinion that the special character of the 'Mark Rums' of Westmoreland lie in the presence of desirable Higher Ethers. Our chemical knowledge of these is at present very limited but I have satisfied myself by experiments on London rum-experts—*Fiat Experimentum in corpore vile*, that these higher Ethers do in fact constitute the "body" and "character" of our high-class rums.

So far as our present knowledge goes, the higher Ethers of Jamaica rum are restricted to those of acids of even carbon constitution, e.g.:

Butyric Acid	..	.. 4 carbons
Caproic Acid	..	.. 6 carbons
Caprylic Acid	..	.. 8 carbons
Capric Acid	..	.. 10 carbons
Lauric Acid	..	.. 12 carbons

the acids of uneven carbon content such as: Oenanthylic Acid 7 carbons (found in Brandy as the Ether), and Pelargonic Acid 9 carbons have not, so far, been recognised in rum. When we remember that these acids are capable of existing in a large number of isomeric forms and that the forms existing in rum may be peculiar and of perhaps unusually desirable quality, and that the total amount of these Higher Ethers in Jamaica rum varies from 1 lb. in 100 puncheons in a common, clean rum to 1 lb. in 10 puncheons in a German flavoured rum, it is at once apparent how difficult is the chemical problem of solving the secrets of the Higher Ethers of rum. In this small trace of matter lies the whole secret of our rum industry, and whether a rum sells for 2/ or for 10/ a gallon chiefly depends upon its content of Higher Ethers. The difference between a Westmoreland mark rum and a very thin rum for local consumption is due to the same difference.

Production of Higher Ethers.

Speaking generally, we may say that the higher acids which give rise to these heavy, fragrant Ethers are the result of the putrefactive fermentation of organic substances such as dead yeast. They are probably produced in minute traces in all cisterns and vessels where dead yeast has settled. The ground cisterns of Westmoreland appear to retain a good deal of yeast-matter in their crevices and some of the fine body of these rums must be due to this source. In making German rums dunder-muck or the coagulated yeasts in the refuse from the still is a general source from which 'fruity' and 'flavoury' material is obtained.

There is everything still to be learned about this matter and there is no doubt a deeper knowledge of the conditions affecting the production of flavour would greatly add to the pre-eminence and prosperity of all branches of the Rum Industry of Jamaica.

Properties of the Higher Ethers.

The Higher Ethers are oily liquids of boiling point far higher than that of alcohol and progressing with the number of carbons present in the acid from which the Ether is derived. They are possessed of most attractive fruity smells. Caproic Ether has a sweetish fruity smell, Caprylic Ether a strong smell of pineapples, &c. &c.

Although of such high boiling point all these Ethers have an appreciable vapour tension and volatilise with alcohol in such proportion as to give the spirit a marked flavour.

They are insoluble in water and if present in excessive amount would render the rum faulty when diluted.

The value of the Higher Ethers is best appreciated when a rum is "broken down" with water. The Acetic Ether then becomes almost unnoticeable, the Butyric Ether quite faint, while the Higher Ethers or body ethers exert an even stronger fragrance than in the strong spirit. The merest trace of Caprylic Ether will dominate a large volume of spirit so as to give it a fragrant smell of pineapples that is very lasting.

One of the problems of the manufacture of High Ether rums in Jamaica is that of securing the most desirable kind and quantity of these "body" or "flavour" Ethers of the higher fatty acids.

CLASS III.

Special Rums of Medium Ether Content.

Certain estates in the island make rums with from 400 to 700 parts of Ethers that fetch 1s. to 1s. 6d. per gallon more than ordinary rums and are used for certain purposes.

Tea Rums are light-bodied rums containing a good deal of Acetic Ether but in addition some delicate and fragrant Ethers of the most pleasing quality. These rums are used on the continent for giving "body" to afternoon tea.

A small dose of such a rum in a hot cup of tea gives off a very pleasant fragrance and modifies that drawback of a cup that, without Ethers, is stated only to cheer.

The market for these rums is limited and they are, as a rule, produced on estates where they result from the simplest process of manufacture.

Rums of this class should not be altered and all that is desirable is to ensure a regularity in the quality of the delicate aroma.

Other estates make a heavier-bodied rum, midway between a Westmoreland mark rum and an "export" or German flavoured rum and these are doubtless used for blending purposes, chiefly in the United Kingdom.

It has been objected that any protection of Jamaica rums in England

would result in hardship to rums of this quality. This, to my mind, is not a sound view to take. Any education of the public to understand what a genuine "Jamaica" rum should be will react on the blenders and induce them to be more eager than ever for a supply of full-bodied Jamaica blending rums to bring up the patent still rums to somewhere near the same standard as that of a Jamaica rum.

It is no exaggeration to say that the establishment of a 200 standard of Ethers for Jamaica rum would at once put a premium on good Jamaica blending rums to bring up the patent still rums to a higher standard.

Owing to the absence of a differential tariff on home and foreign spirits in the United Kingdom, it would appear that High Ether rums would be no more desirable in England than are the present German rums and that the standard would only tend to appreciate the value of bodied Jamaica rums of medium Ether Content.

CLASS IV.

German Flavoured Rums.

Owing to the Tariff Wall which Germany erects to exclude all foreign competition with home industries, Jamaica rum of the ordinary kind can only have a limited market in that country. Whereas the local spirit pays an excise of 2s. per gallon, the imported Jamaica Rum is taxed 10s.

To get over this difficulty, planters in Jamaica were gradually encouraged to increase the flavour of their rums to such an extent that they could be profitably imported into Germany for blending with silent spirit and enable blenders to produce a 'blended Jamaica Rum' saleable at a reasonable price.

Owing to the demand for cheap spirits and the enterprise of chemical manufactures, a large trade in "Artificial Rum" now exists on the continent with which our Jamaica German flavoured rums have to compete.

It may be stated that our German rums vary from 800 to 1,400 parts of Ethers and that their commercial value does not depend upon the actual content of Ethers. Given the same type of Ethers, the Ether Content will measure fairly closely the commercial valuation to be expected. Each estate produces a peculiar flavour and an expert can at once recognise the origin of a sample submitted to him.

The manufacture of these rums is most wasteful of material and although flavours of a very pleasing and desirable quality are obtained in many cases, the output is small and the financial results frequently disappointing.

Speaking generally, about $\frac{1}{4}$ of the total fermentable matter is turned into acids in this process. Of this $\frac{3}{4}$ is turned into acids of no service in the manufacture, and finally only 1/40 of the acid produced is recovered and sold in the rum.

There is therefore a sheer loss of one quarter of the rum-producing material at the very outset, quite apart from the serious losses that occur in the process of fermentation under acute conditions of acidity.

To ensure a standard of 1,000 to 1,200 parts of Ethers in this flavoured rum, an acidity of 2½ to 3% must be attained in the liquor as sent to the still.

The Ethers are then concentrated in the first runnings, while the low wines are distilled separately and yield about 30% of the rum crop as low-wines rum. This latter product usually sells at a little less than an ordinary common clean rum and always has a faint taint of fusel oils. It is thus evident that this process is most wasteful and unless a high price is obtainable for "liquor rum" the proceeds may be even less ssatisfactory than the manufacture of common rum.

The control of acidity is a point hitherto entirely neglected by the makers of German rum. Every worker in a Jamaica distillery should use a Burette and a standard solution of alkali adjusted so that each unit on the Burette run into 10 units of the liquor will equal 1 lb. of acid per 100 gallons. Phenol Phthalein is used as an indicator.

The Department has imported 50 sets of these appliances and any manager can have a set with working instructions free on request.

CLASS V.

High Ether Rum.

In 1902 the writer requested the Government to ascertain through the Foreign Office as to the conditions of the trade in "German Rum" sent from Jamaica to Germany.

A report was received that the trade was of small proportions and owing to the heavy duty on foreign spirits as compared with local spirit and the development of artificial rum flavours it was anticipated that even this small trade would soon cease.

So energetic are the makers of artificial rum flavours that last year every estate in the island was presented with a small sample of essence of Jamaica rum made in Germany which was recommended for improving our ordinary rums!

While the duty on Jamaica rum remains at 10s. and that on German silent spirit is only 2s. per gallon, it is obvious that we can only compete with the artificial rum by making a Jamaica rum of very concentrated flavouring.

To achieve this end, the writer invented a process which is being protected by Letters Patent in all rum-producing countries by which the Ethers of rum can be enormously increased.

Instead of bringing the acids and the alcohol together in a dilute state in the still, the acids are added to the High Wines in the retort and an advantage of 10 to 1 attained in Ether production.

Planters have often tried adding acid fermented liquid to their High Wines but owing to the reduction of the charge from the dilution resulting from this procedure the outcome was not a practical success.

To get over this difficulty a simple chemical procedure has been worked out that enables the distiller to put the acids into the High Wines without appreciable dilution. A working description of this process is given in the next section.

Commercial Basis of High-Ether Rum for the Continental Market.

We can produce a rum of 4,000 to 6,000 Ethers by adopting the High Ether process on any estate at present making German rum.

Two retorts can be used and the whole crop made into one quality instead of having 30% low wine rum as at present. Without any alteration in the fermentations or the materials used, it is now possible to make a rum of at least 4 times the flavouring power of the present make of German rums, and to increase the output of high flavoured rum by 30%. The extra cost would not exceed £1 per puncheon.

Now consider the commercial advantage of such a product to the German Blender:

Present product (1,000 Ethers)

4 gallons German rum at 4s.	= 16s.
duty at 10s.	= 40s.
20 gallons German silent spirit duty paid 3s. 4d.	= 67s
24 gallons Blended Jamaica rum costing 123s.	
1 gallon cost 5s. 1½d. per gallon duty paid.	

High Ether Rum (4,000 Ethers)

1 gallon High Ether Rum x s.	
Duty	10s.
23 gallons German silent spirit duty paid at 3s. 4d.	76s. 6d.
24 gallons "Blended Jamaica Rum" costing as above	123s.
Estimated value of 1 gallon High Ether Rum to German Blender duty paid	36s. 6d.

In competition with chemical flavourings this product would be worth at the present time about 20s. per gallon duty paid. Moreover, the law requires the chemical rum to be sold as "Artificial" or "Kunst" Rum, whereas the blended High Ether rum would be sold as "Blended Jamaica Rum."

It is obvious that even if we could sell a 4,000 Ether rum at 10s. per gallon the profits would be enormous.

Is the demand Limited?

So far as I can ascertain, the present 'German Rum' trade of Jamaica represents but a very small item in the continental rum trade (only about 1,300 plns. a year.) There is room for a very greatly increased output of high-flavoured rum if we can produce it at a price to compete with the chemicals. This can be done and yet leave a magnificent profit.

The French market has lost 2,000,000 gallons of Martinique rum owing to the volcanic eruption at St. Pierre and this is at present being supplied in the form of essence from Hamburg blended with French alcohol. A great market should therefore exist here.

The High Ether process enables an estate to run a flavouring system quite independent of its ordinary fermentation and by distilling 'flavour' separately it is possible to make any portion of the crop into High Ether rum without introducing into the dunder the excess of acids and impurities that bring about slow and poor attenuation.

It is suggested that perhaps 10 to 20 per cent. of the crop on many estates could be profitably made into High Ether rum for the continental market, while the main bulk of the rum could be made precisely as at present.

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WORKING INSTRUCTIONS

FOR

OPERATING THE HIGH ETHER PROCESS.

I. GENERAL METHODS.

A. The Lees.

The lees from the retort, or the two retorts where such are in use, contain acids identical in kind and similar in proportion to the acids existing in the Ethers of the rum which has been obtained from the distillation.

If we can recover these acids and introduce them into the next charge of High Wines we shall greatly increase the content of Ethers in the rum.

N.B. The lees dealt with in these instructions are only the waste liquor from the retorts and not dunder from the still or other waste products.

B. Liming the Lees.

The lees should be collected in a suitable vessel, preferably of wood. Cooper is liable to corrosion and Iron is unsuitable for the same reason.

Lime the lees with temper-lime prepared as follows:—

Slake the Lime and when it has crumbled down sift it to get rid of unburnt limestone. Stir up the sifted material in water to yield a thick milk of Lime and add this gradually to the lees with stirring until the liquid just gives a pink colour when a sample is tested with Phenol Phthalein. Use care not to add any unnecessary excess of Lime and to exclude lumps of unburnt limestone. If the lees contain acids capable of yielding "good body" an appreciable precipitate of insoluble lime salts will take place.

The Acetate and Butyrate of Lime are soluble while the higher members of the series, Caprylic and Capric Acids, give insoluble Lime Salts.

On this account, it is desirable to preserve as much of the sediment as possible when transferring the liquid to the evaporating plant.

C. Evaporating the Limed Lees.

This can be done in an open tayche or a steam jacketed vessel.

It is necessary to see that the Lime Salts are not *overheated* and, at the same time, unless properly dried they will hold so much moisture as to reduce the strength of the High Wines charge.

For convenience and security it is desirable to have the evaporation done by direct steam in a vessel holding say 100 gallons which can be fed from a receiver holding limed lees. It is desirable when the lees are nearly evaporated, to dry the residue with *exhaust steam* only as high-pressure steam dries up the Lime Salt into a hard mass that is difficult to dissolve in the next process and causes much delay.

For temporary work, a small copper steam-jacketed pan to hold 20 gallons is ample. The preliminary concentration can then be done in an open tayche or colour-burning pan. If the whole process is to be done over direct fire, great care will be required towards the end not to burn the Lime Salts. A good plan is to finish the drying by placing the damp residue in bags and drying over a boiler or other hot place.

D. Weighing the Lime Salts.

Every 16 lbs. of Lime Salts, if properly prepared as here directed, free from excess of Lime, dry and yet not burnt, will require 10 lbs. of Sulphuric Acid for treatment and will supply 1 per cent. of acidity when added to 100 gallons of wines. The Lime Salts should therefore be weighed so as to guide the operator as to the amount of acid to add.

Roughly, every 1 per cent. of acidity in the High Wines will give 1,000 Ethers in the rum. It is recommended when making High Ether rum to work at 6% (or 96 lbs. Lime Salts to every 100 gallons of High Wines) for the first still and at 5% for every successive still where the High Wines from a previous High Ether still are used over again. This will give a rum of 4,000 to 6,000 Ethers in practice.

E. Treating the High Wines.

For a single experiment only, temporary arrangements suffice as follows:—

In a puncheon place the charge of High Wines of known quantity. Then add the requisite weighed charge of dry Lime Salts. For every 16 lbs. of these add 10 lbs. of strong Sulphuric Acid. This can be obtained from America in iron drums holding 1,500 lbs. at a cost of about £7 delivered. Smaller quantities can be obtained locally in carboys at an increased rate.

The acid is very corrosive and the negroes should be cautioned that it will burn anything it touches. Also it must be added slowly to the High Wines as it generates heat. When the acid has been added close the bung-hole and roll the puncheon about. The hole should be opened occasionally to liberate any carbonic acid gas generated from undissolved lime stone in the Lees Salts. After standing for not less than 24 hours and preferably 48 hours, with occasional rollings and stirrings the contents are ready to be filtered.

Have a frame made of oak staves of hexagonal shape standing on short legs and of size to hold 20 gallons and stand easily inside an ordinary puncheon. Line the bottom and sides of the frame with copper gauze as used for centrifugals or plain 30 meshes to the inch wove wire

cooper gauze. Prepare a puncheon with cock at bottom and cover to fit tightly over the top with hole in the centre. Stand the filter frame inside the puncheon so that the centre is just under the hole in lid of puncheon.

Then allow the contents of the puncheon in which the Wines and Lime Salts and Acid have reacted to flow into the filter. The Sulphuric Acid unites with the Lime in the Lime Salts producing a thick sludge of Sulphate of Lime, while the acids are set free in a concentrated state in the High Wines. We thus introduce into the Wines nothing but the acids naturally present in the distillate from the still.

The liquid passing through the filter need not be quite clear. So long as it is freed from the bulk of the sludge that is enough. The filtered wines should be stored in an air-tight vessel and used for charging the High Wines retort. Where two retorts are used, the lees from both retorts are used but the wines for the High Wines retort alone are intensified.

Testing Wines for free Sulphuric Acid.

Before filtration of the treated wines, it is desirable to test whether the right amount of Sulphuric Acid has been used. Draw off a clear sample or filter a cloudy one through blotting paper and put in a test tube.

Add 2 drops of Calcium Chloride Solution, if no precipitate insufficient acid has been added and a little more Sulphuric Acid should be introduced into the wines.

If only a faint precipitate with very little deposit is produced in adding the test, the acidity is just right. If a large precipitate appears, add Lime cautiously to the wines with thorough stirring of the liquid until a filtered sample only gives a slight precipitate when tested with Calcium Chloride.

If the lees are carefully limed, there will have been no mistake over this and the correct acidity will be assured.

CAUTION.

Unless the wines are protected from evaporation during this process there will be great loss of Ethers and the strength of the charge be greatly reduced.

The Distillation.

Proceed as usual. Keep the rum separate from the ordinary make and also the High Wines. The latter should be used for the next operation with the process and will have a lot of Ethers already present. Next time perhaps 4% of acidity =64 lbs. of Lime Salts in 100 gallons wines would suffice to yield the same standard of Ethers in the rum.

Be careful not to throw away the lees from the High Wines retort as the bulk of the acids will remain therein and save much evaporation for the next experiment.

Systematic Working.

To save labour, certain arrangements are desirable to carry out the High Ether process systematically.

Provide a pump to lift the lees from lees receiver in connection with discharge from retorts to a receiver placed at a convenient height above the evaporating plant. Lime the lees in this receiver and allow a steady stream of limed liquid to fall into the evaporating plant.

The plant for treating the wines should be erected in the Rum Store or in a locked room to satisfy the Excise officers. The wines should be delivered by a pump into either of two receivers each capable of holding 4 charges for the retort. While one is being treated, the other can be used. These wines receivers should have a man-hole for admitting the Lime Salts and the Sulphuric Acid and should be fitted with a spindle with paddles that can be turned by a handle or by a bevel-gearing from outside. Below these receivers must stand the filters and below these again receivers to hold the same volume as the upper ones. A pump should then lift the filtered wines to the charging butt which should be equipped with a glass guage.

Special Procedure.

1. *To make common or ordinary High-Ether rum for grading up the crop to a good standard of Ethers.*

Evaporate the lees from 8 to 10 stills and introduce into charge as above described. Advice can be given from analysis of Estate's rum and High-Ether rum as to how much to add to each vat or puncheon.

2. *To intensify the body of a Rum by selection of lees Lime Salts.*

Evaporate the lees, after liming, until reduced to a small bulk, say 1/10 original volume. Stop the evaporation, scrape all the deposit and filter the muddy liquid. Collect the insoluble residue which will be the Lime Salts of the 'fruity' and 'body'-producing Acids and use them for mixing a High Ether rum. This is recommended for rums of Class 2, where body is the chief thing aimed at.

3. *High Flavoured Rums.*

It will probably be found in practical working that perhaps only a half of the usual amount of acid will be required when making a High-Ether rum from ordinary German rum materials while the 'flavour' will require to be kept up to a good standard.

4. *Improved High Flavoured Process.*

A. Set up a good, clean fermentation at 16 to 17 Brix, 24 to 26 Jamaica Saccharometer. Keep dunler, etc., clean and do not admit the flavouring materials into the alcoholic process.

B. Have 1/10 of the fermenting space reserved for making vinegar. Set up sweets only at 8 to 10 Brix (12 to 15 Saccharometer). After attenuation, let them pass through the "quick vinegar" process previously described. 3 % of volatile acidity should be obtained in 10 days in this way.

C. Set up Butyric system, sweets, fresh skimmings or molasses, set up weak in a vessel with a little earth at bottom and the liquid

filled with cane trash. Add 20 lbs. chalk or good marl to every 100 gallons. After 6 weeks, add 16 lbs. of Sulphuric Acid. Stir thoroughly.

D. *Putrefactive or Flavour System.* Collect all the dunder muck, dead-wash bottoms, etc., with trash and allow to putrefy. This is a slow process and a large stock should be prepared ahead of crop.

E. Distil a blend of B, C and D with some dunder to obtain the volatile acids. When the still has run fairly low, fill up again with water and evaporate again to get a good yield of the heavy acids collect the distillate and lees from retorts. Lime and evaporate down. Introduce into High Wines.

Charge still with A as usual.

This gives in outline a system of working that the writer believes would enable an estate to make either common, clean or High-Ether rum at will and without involving the serious alteration in fermentation resulting from the adoption of the ordinary process of making high-flavoured rum.

Final Caution.

The whole of these recommendations are based upon experiments that have only just been made and these methods are of necessity still in the experimental stage. They are, however, considered of sufficient value and significance to warrant a careful study and trial by all managers who desire to improve the commercial value of their rum.

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